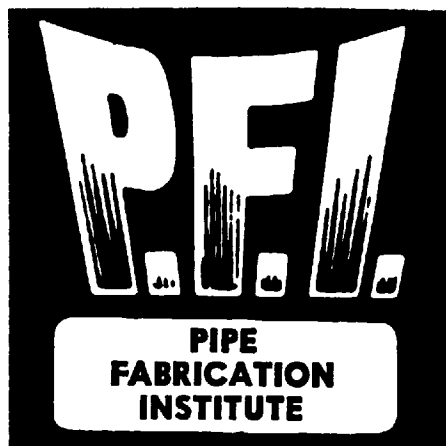


Welded Load Bearing Attachments To Pressure Retaining Piping Materials

Prepared by
Pipe Fabrication Institute Engineering Committee



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P. O. Box 173 ● Springdale, PA 15144

WELDED LOAD BEARING ATTACHMENTS TO PRESSURE RETAINING PIPING MATERIALS

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A current index of the latest revised ES Standards and Technical Bulletins is available from the Pipe Fabrication Institute.

PFI Standards and Technical Bulletins are published to serve proven needs of the pipe fabricating industry at the design level and in actual shop operations. Hence, such needs are continually considered and reviewed by the Engineering Committee of the Pipe Fabrication Institute to provide recommended procedures which have been demonstrated by collective experiences to fulfill requirements in a manner for Code compliance. However, as the PFI Standards are for minimum requirements the designer or fabricator always has the option of specifying supplementary conditions in the form of requirements beyond the scope of the PFI publications.

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METRIC CONVERSIONS

The conversion of quantities between systems of units involves a determination of significant digits to be retained. All conversions depend upon the intended precision of the original quantity and are rounded to the appropriate accuracy.

Pipe sizes together with applicable wall thicknesses are not shown with metric equivalents.

The SI (metric) values were included with the customary U.S. values in this Standard are the rounded equivalents of the U.S. values and are for reference only.

Metric units were derived utilizing the following conversion factor:

Conversion	Factor	Conversion	Factor
Inches to	25.4	Deg. Fahr. to	5/9 (Deg. F.—32)
Millimeters		Deg. Cent.	
Lb/in ² to	0.0703		
Kg/cm ²			

Preface

Industry recognizes that in the support of piping, the most practical arrangement for field erection for attachment to piping is the use of non-integral attachments such as pipe clamps. However, as use of non-integral type attachments is not always feasible for all locations, an alternate arrangement becomes necessary. The intent of this standard is to provide procedures to apply for utilization of integral-type support attachments.

1. Scope

- 1.1 This standard covers minimum recommended requirements for materials, design, fabrication and inspection of load bearing attachments, such as, but not limited to, ears, shoes, lugs, fins, rings, skirts, anchors, guides, etc., which are to be fabricated and welded to piping materials that will become part of a pressure retaining piping system. It is not intended to apply to lug or clip attachments whose basic function is to provide support for pipe insulation.
- 3.2 The maximum allowable stresses to apply to the attachment shall be those given in the applicable Code for the nominal composition of the attachment material to be used, but in no case greater than the allowable stress for the piping material to which it is to be welded.
- 3.3 The maximum allowable design stresses to apply for filler metal shall be those listed in the applicable Code for the nominal composition, but in no case greater than the allowable stress for the piping material to which it is to be attached.
- 3.4 The allowable supporting loads per linear inch or centimeter, of fillet welds shall not exceed those listed in Table 1.
- 3.5 To minimize differences in thermal expansion of contact surfaces, the coefficient of thermal expansion of the attachment should be the same or as close as possible to that of the piping material to which it is to be welded.
- 3.6 Each attachment shall be designed for support of all imposed loadings consisting of but not limited to the following:
 - a. Static loads as determined by weight balance calculations including weight of the pipe, insulation and the weight of fluid content, cleaning fluid or fluid used for hydrostatic testing, whichever is the greatest.
 - b. All other external loading as specified by the piping design that may be imposed by such conditions as:
 1. Dynamic loading due to safety valve operation, or other system operation.
 2. Thermal fatigue loading due to load changes on restraints and anchors.
 3. Additional static loadings imposed by cold pulling during erection.
 4. Eccentric loading conditions during operation.
 5. Any other external loadings such as snow or wind.

2. Material

- 2.1 All material shall conform to the requirements of one of the acceptable material specifications listed or referenced in the ASME B31 Code for Pressure Piping or the ASME Boiler and Pressure Vessel Code as applicable.
- 2.2 All material shall be of weldable quality and shall be of the same type or of compatible composition with the material to which it is to be welded.
- 2.3 All filler metal shall comply with the requirements of Section II, Part C ASME Boiler and Pressure Vessel Code. A filler metal not incorporated in Section II may be used if a procedure qualification test is first successfully completed in accordance with Sec. IX requirements.

3. Design

- 3.1 The design temperature to be used for the attachment shall be the same as the design temperature of the piping to which it is to be welded.

- 3.7 Since the character of loadings, amount of loading and attachment location on piping are variables, no uniform or suggested standardized shapes or dimensional proportions are possible. Hence, individual consideration is necessary in the design of each attachment. The typical shapes illustrated by Figures 1 through 7 are not necessarily design recommendations for all applications.

Prime areas of concern are:

- Localized stresses induced into the piping component by integral welded attachments on lines operating at elevated temperatures.
- The differential expansion stresses between the attached lug and the pipe.
- The differential expansion stresses in the attachment lug itself. Very little experimental data has been obtained on the performance of various lug designs; however, operating experience has shown certain types to be more desirable than others. Figure 5 illustrates a type of integral attachment that is acceptable for low thermal differential stresses. Figure 6 depicts an acceptable design for large thermal differential stresses.

Loading can be distributed over a larger area by use of a pad between the attachment and the pipe as shown in Figure 4. This is useful on light wall pipe subjected to high anchoring stresses, impact loads, or seismic loads.

Impact and shock attachments can be made as shown in Figure 7, by using double shear lugs and a pipe clamp. This method is recommended in place of an integral welded attachment.

Because of the tolerances involved in attaching shear lugs to the pipe and the alignment with the top surface of a riser clamp that is not machined or faced, the following table is recommended for selecting the number of shear lugs:

Pipe Size	Min. No. of Lugs	No. of Lugs Designed to Support Load
6" & under	2	2
8" & larger	4	2

Orientation of lugs should be as shown in Figure 3.

The effect of external loading on the piping design, together with overall effects resulting from differential thermal conditions of pipe and attachment, shall be the responsibility of the piping designer.

- 3.8 Welding of attachments to arcs of pipe bends and curved sections of fittings should be avoided whenever the alternate choice of welding to straight pipe is a practical option. However, when the optimum design arrangement requires welding to curved pipe or fitting surfaces, the effect on system flexibility, intensification factors and attendant conditions resulting therefrom shall be evaluated by the piping designer prior to use.

4. Location of Welded Attachment on Pipe

- The location of each attachment with respect to a specific point on the piping system shall be specified by the support design. When the piping is to be cut short and cold sprung during erection, each attachment location shall include allowances for the effect of such conditions.
- Orientation location of the attachment with respect to the normal transverse or longitudinal axis of the pipe shall be included with the location data requirement stated in Para. 4.1.
- Except for welded lugs for use with riser clamps, each attachment shall extend outside the insulation to prevent interferences with insulation at point of external loading attachment.

5. Types of Attachment Welds

- Attachment welds may be of the fillet or full penetration type, unless otherwise specified by the engineering design or required by the applicable Code.

6. Linear Tolerances on Attachment Locations

- Linear tolerances applicable to integral attachments in the as welded position are shown in Figure 1. Compensation for variations in excess of these tolerances may be by field adjustments which are inherent in hanger hardware design.

7. Welding Procedure

- Welding of attachments to pipe shall be by use of welding procedures and by welding operators qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code. Tack welds permitted to remain in place shall be made by a Section IX qualified welder.

8. Preheat and Postheat Treatment of Welds

- Requirements for preheat and postheat treatment of welds shall be in accordance with the requirements of the applicable Code.

9. Non-destructive Examination of Welds

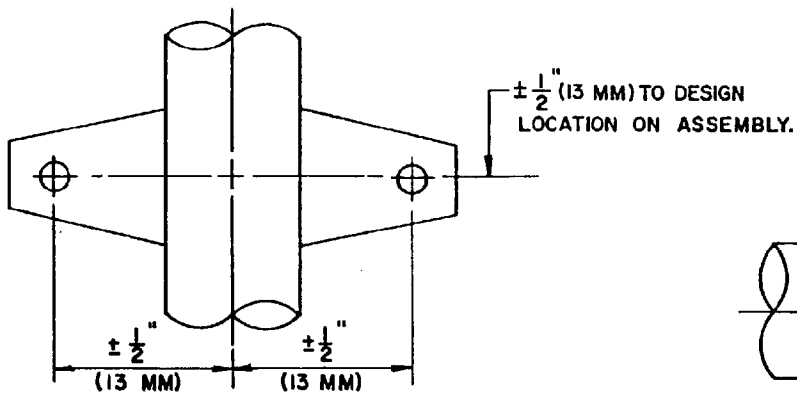
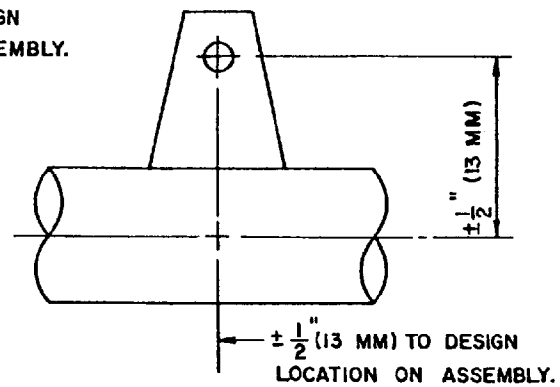
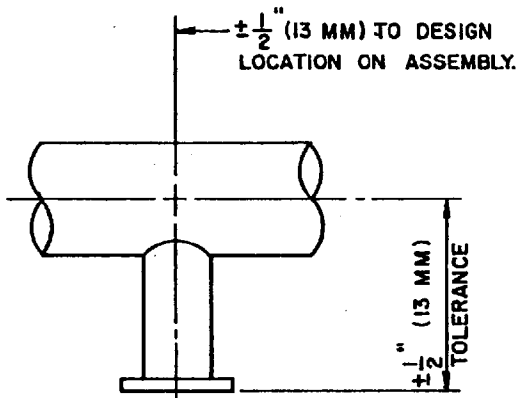
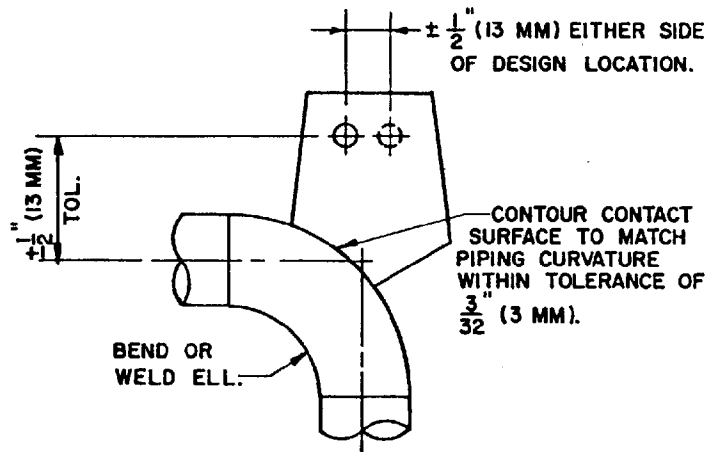
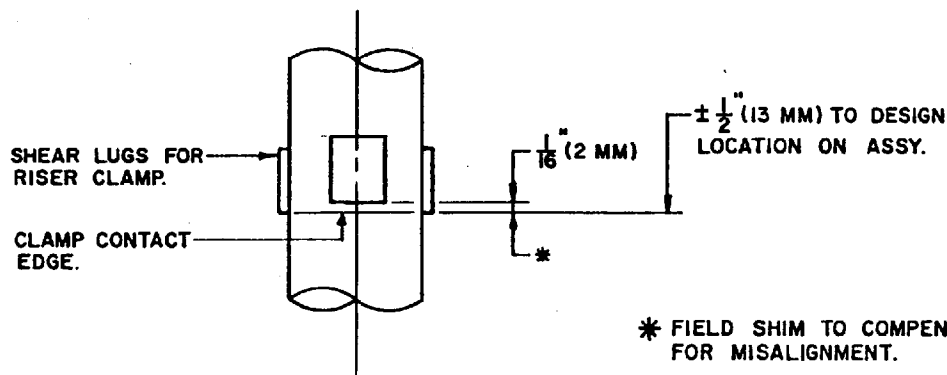
- When specified by the engineering design or required by the Code applicable to the piping, examination of ferritic weld surfaces shall be by the magnetic particle or liquid penetrant method and of stainless weld surfaces by the liquid penetrant method. The procedure and basis of acceptance to apply for either shall be as stated in the engineering design.

TABLE I
MAXIMUM ALLOWABLE LOADS ON FILLET WELDS JOINING LOAD BEARING ATTACHMENTS TO PIPING
BASED UPON SHEAR LOADING FOR ALLOWABLE SHEAR STRESS "S" VALUES SHOWN

LEG OF EQUAL LEG OF FILLET WELD (1)	MAXIMUM ALLOWABLE LOAD PER UNIT LENGTH OF WELD										NOMINAL COMPOSITION, TEMPERATURE, AND STRESS LISTINGS (2) (4)		UNITS		POUNDS/INCH		KILOGRAMS/CM		MATERIAL	
INCHES											CARBON STEEL (2)		1 1/4 CHROME - 1/2 MOL Y (2)		2 1/4 CHROME - 1 MOL Y (2)		18 CHROME - 8 NICKEL (2)			
CENTI- METERS																				
1/8"																				
3/16"																				
1/4"																				
5/16"																				
3/8"																				
1/2"																				
5/8"																				
3/4"																				
7/8"																				
1"																				
1 1/8"																				
1 1/4"																				
1 1/2"																				
1 5/8"																				
4 1/4"																				

NOTES:

- (1) Minimum leg length of fillet weld to be 1/8".
- (2) The allowable loads in Table I are based on the allowable stress values as defined in the ANSI B31.1 and ASME Section I Code and are based on the smaller of the base material strength or the welding materials strength as follows:
 - (a) Carbon steel, 1 Cr, 1 1/4 Cr, 2 1/4 Cr, — 60,000 PSI minimum specified tensile strength.
 - (b) 18 Cr — 8 Ni — 75,000 PSI minimum specified tensile strength.
- (3) For allowable load per linear inch of fillet leg length for allowable shear stresses other than shown, multiply the allowable stress in the applicable code by the product of the fillet leg length multiplied by the factor 0.5656.
 - (a) The factor 0.5656 is the product of 0.80 multiplied by 0.707, where 0.80 is reduction in tensile stress for shear loading and 0.707 is the shear length of the fillet.
 - (b) As most loadings are a combination of tension and shear, the above table is based on shear loading.
- (4) The load values in this Table may be interpolated to determine values for intermediate temperatures. The last two digits of the loads shown in pounds/inch have been rounded off to the next lower unit of 25.
- (5) The allowable shear stress values shown are in thousands of pounds per square inch and in kilograms per square centimeter.

**TYPE I****VERTICAL PIPE INSTALLATION****TYPE II****HORIZONTAL PIPE INSTALLATION****TYPE III****BASE SUPPORTS & GUIDES**
PIPE HORIZ. OR VERT.**TYPE IV****ATTACHMENTS TO CURVED SECTION**
(SEE PAR. 3.8)

* FIELD SHIM TO COMPENSATE FOR MISALIGNMENT.

TYPE V**VERTICAL PIPE INSTALLATION****FIGURE 1****APPLICATION OF WELDED ATTACHMENT TOLERANCES**

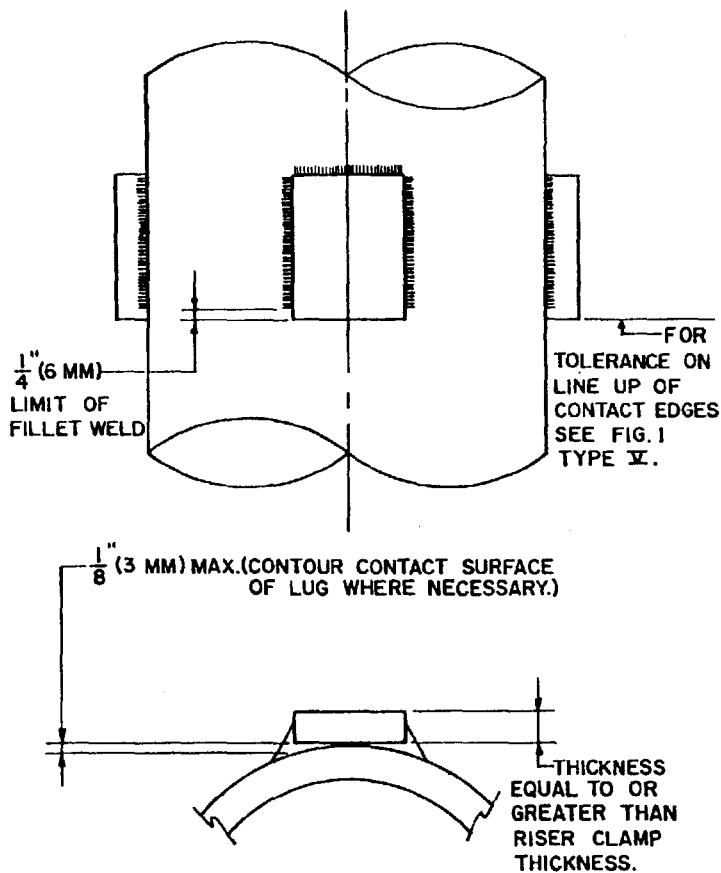


FIG. 2

TYPICAL SHEAR LUGS FOR CLAMPS

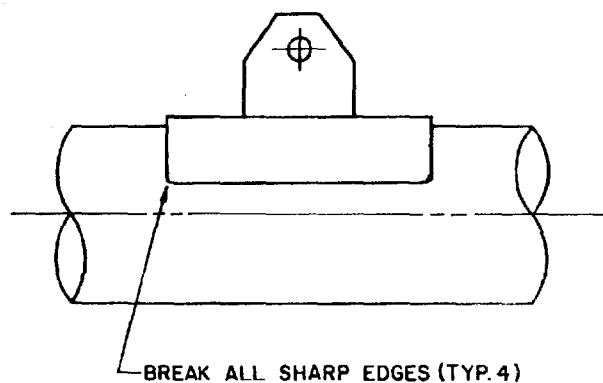


FIG. 4

TYPICAL APPLICATION OF LUG & PAD

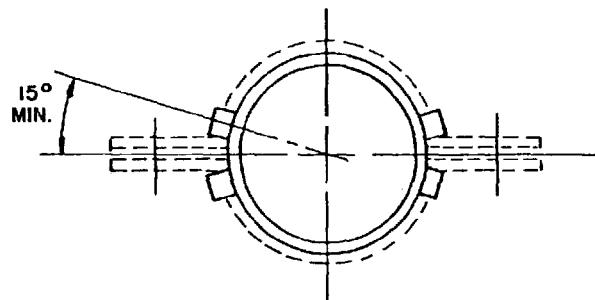


FIG. 3

**TYPICAL ORIENTATION OF
SHEAR LUGS WITH CLAMP**

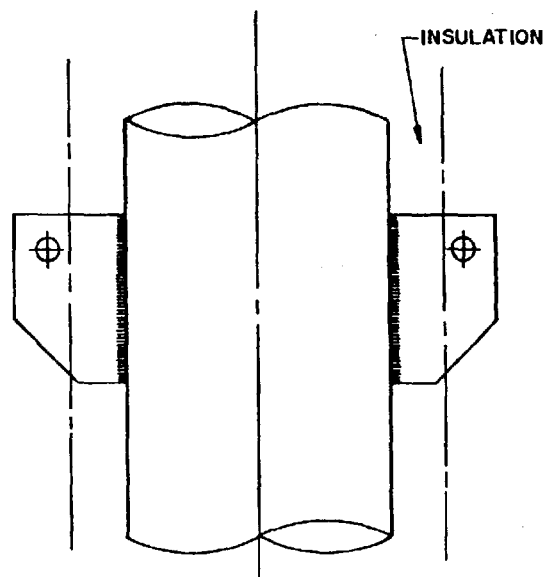


FIG. 5

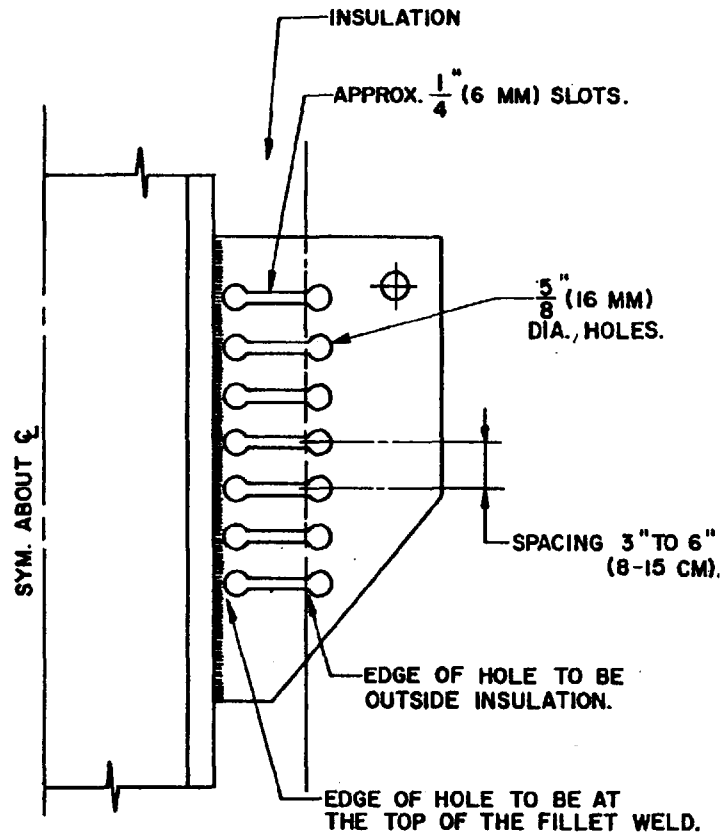


FIG. 6
TWO TYPICAL METHODS OF PROVIDING
RELIEF SLOTS

